Page 86, first full paragraph

A2

In this embodiment UNDX (Ono, I. And Kobayashi, S: A Real-coded Genetic Algorithm for Function Optimization Using Unimodal Normal Distribution Crossover, Proceeding of 7th International Conference on Genetic Algorithms, pp. 246-253 (1997)) is adopted as a crossover operator. The UNDX generates, from two parents of parent 1 and Parent 2 out of selected parents, two children according to a normal distribution set around them, as shown in Fig. 27. The standard deviation of the normal distribution is set so that a component $\sigma 1$ along the major-axis direction connecting the both parents is proportional to a distance between the parents ($\sigma 1 = \alpha d1$ where d1: the distance between Parent 1 and parent 2) and so that a component $\sigma 2$ along the other axis is proportional to a distance between the major axis and Parent 2 ($\sigma 2 = ßd2$, where d2: the distance between parent 3 and the axis connecting parent 1 with Parent 2). Fig. 27 illustrates an example of two variables.

Page 92, second full paragraph

A3

Fig. 38 shows a state in which the best solution P (the lens system shown in Fig. 31) obtained in Experiment 1 of the first embodiment described above is plotted on the enlarged view of Fig 37. In the drawing letter Q indicates lens systems dominating the solution found by the single-objective optimization of the evaluation criteria. As also apparent from this Fig. 38, it is clearly seen that the second embodiment (multi-objective optimization) obtains many more excellent solutions that that obtained by the single-objective GA. This conceivably suggests that there is a possibility of making the problem harder if the multi-objective problem is forced to the single-objective problem.

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A4

Fig. 39 is a schematic diagram of the structure of the photographic lens system. In this figure g designates the image plane. The photographic lens system of this figure is an example of the three-lens configuration, in which there are six boundary surfaces of a to f having their respective curvatures, and six distances of d1 to d6 between the boundary surfaces (d1 between A and B, d2 between B and C, d3

A

A4

between C and D, d4 between D and E, d5 between E and F, and d6 between F and G).

Page 100, second full paragraph

A5

Fig. 41 illustrates a gene representation of ten parameters of continuous values featuring the lens system in the three-lens configuration shown in Fig. 39. In each of a-e and d1-d5 in the same drawing a parameter of the corresponding lens system is stored in the form of continuous value. Among such genes, n (n > 1) genes satisfying the minimum constraints are reproduced arbitrarily.

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A6

The n-dimensional coordinates of the point P4 reproduced by above steps ST4-1 to ST4-6 correspond to the n parameters a, b, c, d, e, d1, d2, d3, d4, d5 of a chromosome of a new-born gene or a child. In this step ST4 of the fourth embodiment the substeps ST4-1 to ST4-6 described above are repeated m times, whereby m new genes are reproduced from the three parents Pa1, Pa2, Pa3.

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In the case of the multi-objective optimization, steps ST110 and ST150-ST170 below are executed in place of above steps ST1 and ST5-ST7.

Page 122, second full paragraph, lines 7-13

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Size of initial population: 50

Number of Crossovers: 300,000

Number of children generated by crossover operator: 20

σa of UNDX: 0.5 x VC1VC2

σb of UNDX: 1

σc of UNDX: 0.35 x $(VC1VC2)^{1/n}$

A